

its crispy, spinescently dentate leaves with broad pale midrib and 4-5 cm long heads surrounded by prominently spine-tipped involucral bracts.

Fl. & Fr.: March-May.

Specimens examined: Pathankot, M. Sharma 13598.

8. *Ursinia anethoides* (DC.) N. E. Br. Gard. Chron. 1: 670. 1887; Bailey, Man. Cult. Pl. 1013. 1949; Vishnu Swarup, Garden Fl. 133. 1967. *Sphenogyne anethoides* DC. Prodr. 5: 685. 1836.

A native of South Africa. Often grown in gardens.

Fl. & Fr.: February-April.

Specimens examined: Univ. Campus Patiala, M. Sharma 11737.

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37. LIMNOLOGICAL INVESTIGATION IN THE BACK-WATER LAGOON OF GOPALPUR-ON-SEA

(With two text-figures)

INTRODUCTION

Around 2 Km² area of Gopalpur-on-Sea is periodically flooded by sea water through a back-water-lagoon. Since the sewage and municipal canals are directed to this low-lying back-water lagoon, it is often rich with various nutrients that encourages growth of various

organisms. Although a limited amount of floristic work dealing with algae had been made in the past (Pattnaik *et al.* 1979) attention had not been given to study the limnological aspects of the habitat. The present investigation was carried out to study the water quality, variation in the quantity and quality of phytoplankton during different seasons and the

MISCELLANEOUS NOTES

general vegetation type of the back-water lagoon of Gopalpur-on-Sea.

THE EXPERIMENTAL SITE

The experimental site of around 2 Km² area was at Gopalpur-on-Sea (19°16'N, 84°55'E) on the coastal belt of the Bay of Bengal (Fig. 1). The soil is characterized by high proportion of sand and poor water retention. The climate is monsoonal with three distinct seasons: Summer (March-June), rains (July-October) and winter (November-February). The total rainfall for 1983 was 1200 mm of which 70% fell in the wet season. The mean monthly maximum and minimum temperatures ranged from 28°C (January) to 33°C (May) and 18°C (January) to 26°C (May) respectively. The low lying back-water lagoon of variable depths, rich with aquatic vegetation only during certain period of year, was greatly influenced by the municipal sewage and periodic influx of sea water. The shallow region of the low lying area generally dry up during late winter and summer.

METHODS

Limnological studies were made for the first time in the back-water lagoon of Gopalpur-on-Sea during three different seasons between November, 1983 and September, 1984. Samples and field data were taken from three different stations in the area in each trip. Temperature was recorded on the spot with a mercury thermometer graduated upto 100°C. The hydrogen-ion-concentration was determined using a digital pH meter. Water samples were analysed for the presence of various chemicals according to the methods described in the standard methods for examination of water and waste water (American Public Health Association 1971). Chlorophyll determination was

based on the method of Talling & Driver (1961). From each spot duplicate water samples of 500 ml. each were filtered through 47 mm Millipore H. A. filters with pore size of 0.45 µm. The optical density was measured using an Erma (Japan) spectrophotometer. Samples of planktons were collected by filtering known quantity of water taken from different spots of the study site through a plankton net made of standard bolting silk cloth (No. 21 with 77 meshes/sq. cm.). The concentrated plankton was preserved in 4% formalin and determined qualitatively and quantitatively by sedimentation and drop count method. Various phytoplanktons were identified according to Fritsch (1945) and Desikachary (1959).

RESULTS AND DISCUSSION

Table 1 shows the different physico-chemical parameters of the water from three different spots of the low lying back-water lagoon of Gopalpur-on-Sea in three different seasons of a year. Fig. 2 shows the comparative size of phytoplankton belonging to different groups of algae during the above investigation period. Phytoplankton count showed that the green algae were dominant planktons followed by blue-green, diatoms and euglenoid algal members in almost all the seasons. However, the total number of planktons were significantly reduced during rainy season. This may be due to constant influx of rain and sea water to the lagoon which decreases the concentration of most of the inorganic chemicals (Table 1).

During rainy season a number of *Ectocarpus* sp. commonly occur in the sea water (Pattnaik *et al.* 1979) found growing in the back-water lagoon. However, during winter and summer, *Cladophora* and *Polysiphonia* species were found to be dominant attached forms indicating that the algal flora of the lagoon resembled that of lotic environment.

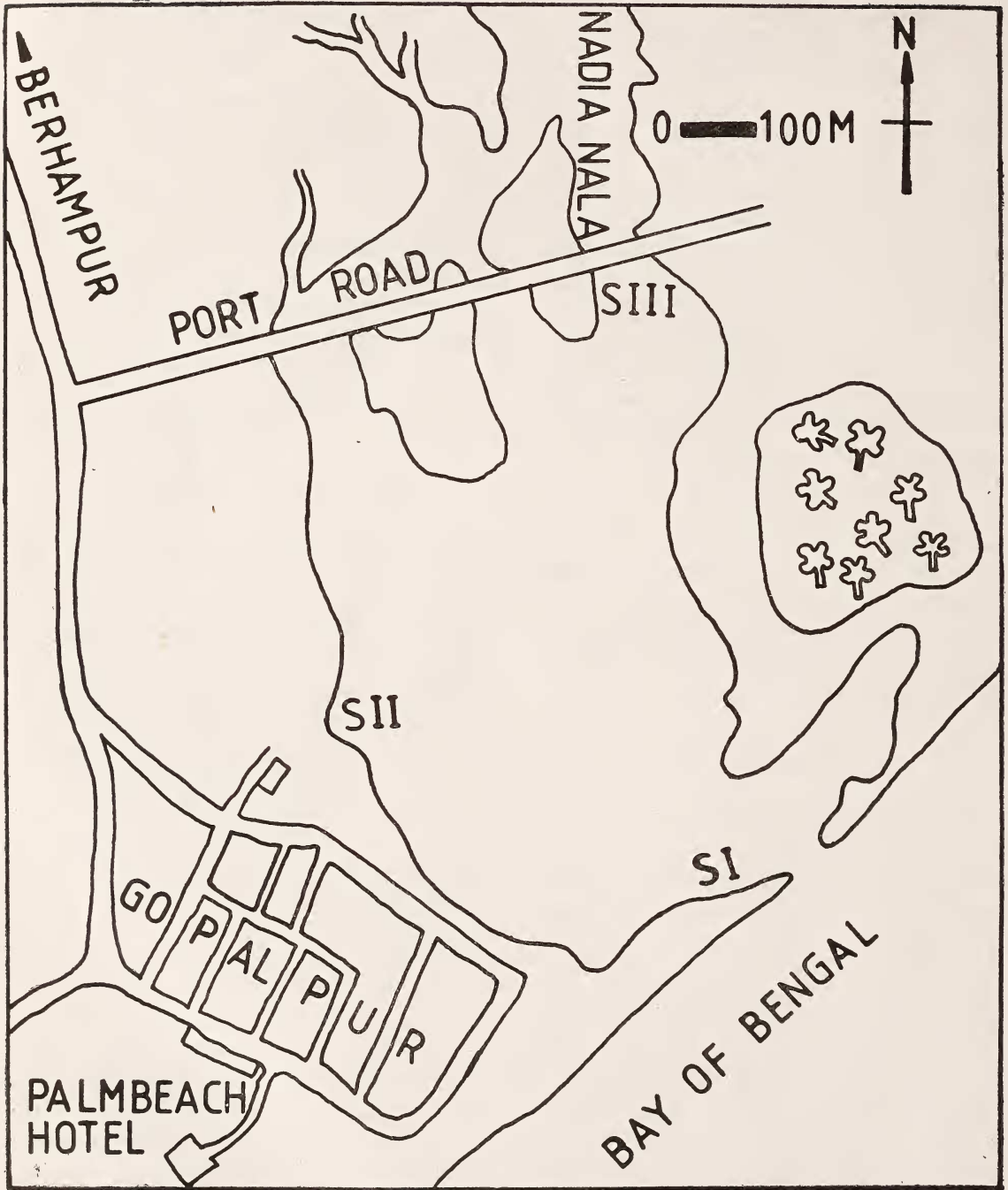


Fig. 1. Area map of the back-water lagoon of Gopalpur-on-Sea.

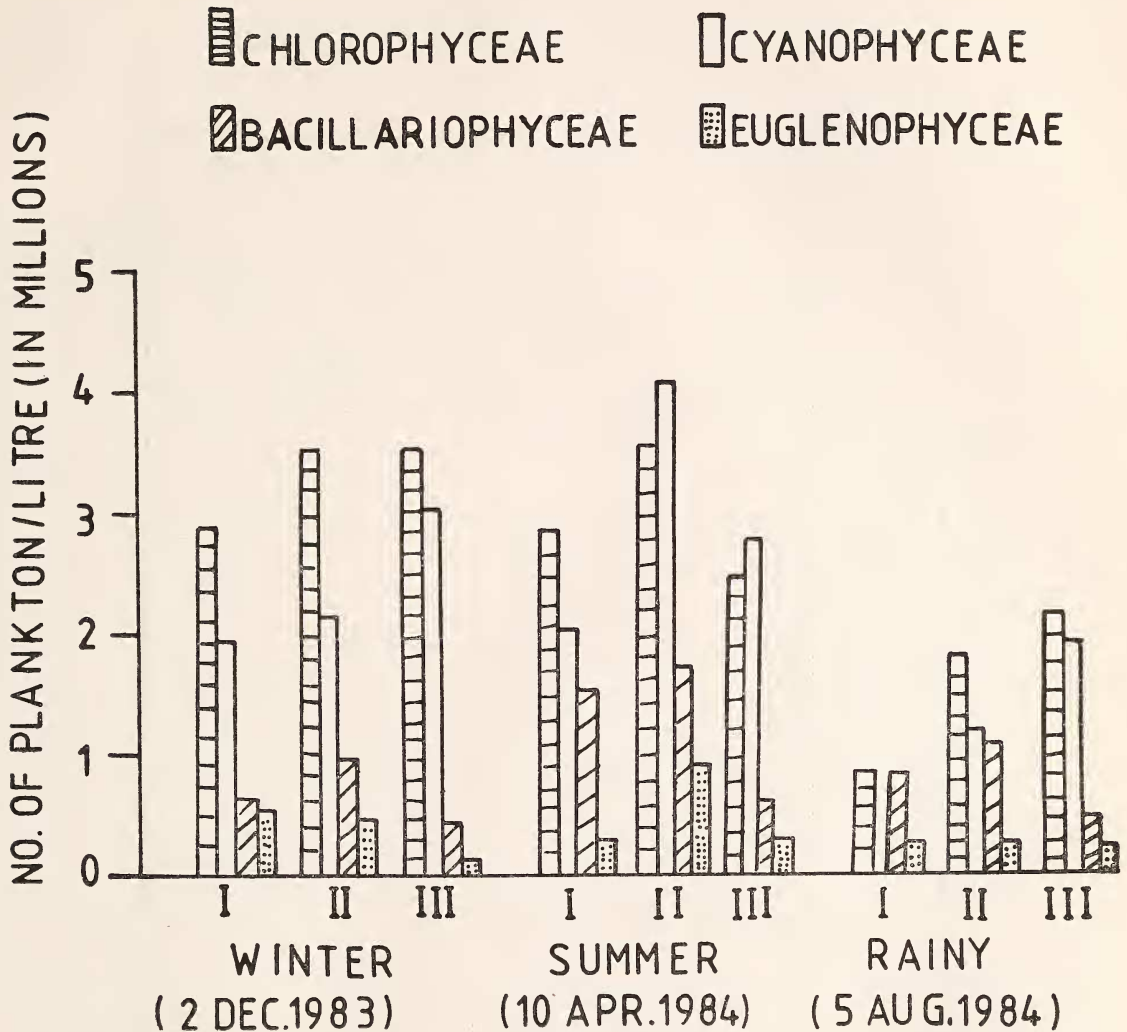


Fig. 2. Histograms showing the comparative size of phytoplankton belonging to different groups of algae occurring in the back-water lagoon of Gopalpur-on-Sea during three different seasons of a year.

The various algal species occurring in different sites of the study area are summarized in Table 2.

In addition to the algal forms, a number of aquatic angiosperms also occur in the back-water lagoon. Mixed vegetation of *Typha*

domingensis Pers. (*T. anustata* Bory et Chaulo) and *Phragmites australis* (Cav.) Trin. ex Steud. (*P. communis* Trin.) was commonly noted in the shallow areas of the lagoon during winter and summer season. *Ceratophyllum demersum* L. was the dominant submerged hydrophyte

TABLE I
 PHYSICO-CHEMICAL PARAMETERS OF THE BACK-WATER LAGOON OF GOPALPUR-ON-SEA AT THREE DIFFERENT SEASONS

Parameter	2nd December 1983 (winter)			10th April 1984 (summer)			5th August 1984 (rainy)		
	Spot			Spot			Spot		
	I	II	III	I	II	III	I	II	III
Temperature °C	25	25	25	29.5	29.5	29.5	26.5	26.5	26.5
Depth (meter)	0.5	2.2	muddy	0.2	1.8	muddy	1.2	3.6	0.4
pH	8.7	8.5	8.1	8.2	8.2	8.0	9.2	9.2	8.9
Carbon dioxide (mg/l)	2.5	4.0	4.0	2.5	4.5	3.0	3.2	3.5	2.5
Dissolved oxygen (mg/l)	5.4	5.6	3.8	4.4	4.4	2.8	4.2	4.6	5.2
Bicarbonate alkalinity (mg CaCO ₃ /l)	180.0	180.0	140.0	180.0	200.0	130.0	170.0	150.0	150.0
Salinity (%)	0.38	0.38	0.36	0.38	0.36	0.32	0.42	0.42	0.36
Ammonia (mg NH ₃ -N/l)	0.12	0.16	0.1	0.15	0.15	0.08	0.04	0.04	0.08
Nitrate (mg NO ₃ -N/l)	1.15	1.15	0.7	1.65	1.65	0.7	0.6	0.6	0.75
Nitrite (mg NO ₂ -N/l)	0.004	0.004	0.002	0.004	0.005	0.002	0.001	0.001	0.002
Phosphate (mg PO ₄ /l)	0.42	0.45	0.35	0.42	0.42	0.28	0.4	0.4	0.3
Silicate (mg SiO ₂ /l)	7.8	8.2	2.5	7.5	7.8	6.0	8.5	8.5	5.2
Sulphate (mg SO ₄ /l)	120.0	120.0	38.0	118.0	110.0	24.0	115.0	120.0	98.0
Chlorophyll-a (mg/l)	2.18	6.64	7.82	8.85	10.55	3.54	0.88	1.25	1.86

MISCELLANEOUS NOTES

TABLE 2

OCCURRENCE OF VARIOUS ALGAL MEMBERS IN THE BACK-WATER LAGOON OF GOPALPUR-ON-SEA DURING THREE DIFFERENT SEASONS

Organism	2.12.1983 (winter)			10.4.1984 (summer)			5.8.1984 (rainy)		
	Spot			Spot			Spot		
	I	II	III	I	II	III	I	II	III
CYANOPHYCEAE:									
<i>Microcystis protoctysis</i> Crow.	-	+	+	+	+	+	-	+	+
<i>Aphanothece bullosa</i> Menegh.	+	++	+	+	++	+	+	++	++
<i>Chroococcus minutus</i> Kütz. ex Näg.	-	+	+	+	++	-	+	++	-
<i>Chroococcus turgidus</i> Kütz. ex Näg.	-	+	+	+	+	-	-	-	+
<i>Gloeotheca palea</i> Kütz. ex. Rabenhorst	-	+	-	-	+	-	-	-	-
<i>Spirulina major</i> Kütz. ex Gomont	-	+	+	+	++	-	-	-	+
<i>Oscillatoria annae</i> Goor	+	+	-	-	+	-	-	-	+
<i>Oscillatoria ornata</i> Kütz. ex Gomont	-	+	-	+	++	+	-	+	+
<i>Oscillatoria rubescens</i> DC. ex Gomont	-	+	+	+	+	+	-	-	+
<i>Phormidium fragile</i> Gomont	-	+	+	+	+	-	-	-	-
<i>Gloeotrichia intermedia</i> Lamm.	-	-	+	+	+	-	-	-	+
<i>Scytonema schmidlei</i> De. Toni.	-	-	+	-	+	-	-	-	-
<i>Merismopedia minima</i> Beck.	+	+	-	+	++	-	+	+	+
CHLOROPHYCEAE:									
<i>Chlorococcum humicola</i> Näg. ex Rabenh.	-	+	-	+	+	-	-	-	-
<i>Pediastrum simplex</i> Meyen.	-	+	-	+	+	-	-	-	+
<i>Tetrahedron muticum</i> Hansg.	+	+	-	+	+	-	+	+	+
<i>Draparnaldiopsis indica</i> Singh	-	+	-	+	+	-	-	-	+
<i>Cladophora rupestris</i> (L.) Kütz.	+	++	+	++	++	+	+	++	++
<i>Ulothrix flacca</i> (Dillw.) Thur.	++	++	+	+	+	+	+	++	++
<i>Ulva lactuca</i> L.	+	+	+	+	+	+	-	-	+
<i>Enteromorpha clathrata</i> (Roth.) Grev.	+	+	-	-	+	-	+	+	+
<i>Cosmarium laeve</i> Rabenhorst	+	++	-	-	+	-	+	+	+
<i>Cosmarium granatum</i> Brebisson	+	+	-	+	+	-	-	+	+
<i>Euestrum spinulosum</i> Delp.	+	+	-	+	+	-	-	-	-
BACILLARIOPHYCEAE:									
<i>Fragilaria intermedia</i> Grun.	+	+	-	-	+	-	-	-	-
<i>Gomphonema constrictum</i> Ehr.	+	+	-	-	+	-	-	-	+
<i>Navicula mutica</i> Kütz.	+	++	-	-	++	+	+	++	+
<i>Navicula radiosa</i> Kütz.	+	++	+	++	++	+	+	++	+
<i>Pinnularia braunii</i> Grun.	+	+	-	-	+	-	-	-	+
<i>Nitzschia communis</i> Rabenhorst	+	+	-	+	+	-	+	+	+
EUGLENOPHYCEAE:									
<i>Euglena gracilis</i> Klebs.	+	+	-	+	++	-	+	+	+
<i>Astasia fritschii</i> Fritsch.	+	+	-	+	+	+	-	-	-
XANTHOPHYCEAE:									
<i>Vaucheria compacta</i> Coll ex Taylor	+	+	-	-	+	-	+	++	-
PHAEOPHYCEAE:									
<i>Ectocarpus siliculosus</i> (Dillw.) Lyngb.	+	-	-	-	+	-	++	++	-
<i>Fucus serratus</i> L.	+	+	+	-	-	+	-	-	+
RHODOPHYCEAE:									
<i>Polysiphonia elongata</i> (Huds.) Spreng.	-	+	+	+	+	-	-	+	-

+, Present; ++, Occur abundently; -, absent.

of this area. In addition, a number of other hydrophytes, viz. *Cyperus* spp., *Vallisneria spiralis* L., *Potamogeton orispus* L., *Utricularia* spp., *Ranunculus* spp. and *Polygonum* spp. also commonly occur around the study area.

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38. ADDITIONS TO THE PTERIDOPHYTIC FLORA OF KUMAUN AND NAINITAL (WESTERN HIMALAYA)

Duthie (1906) was the first to catalogue the Pteridophytic flora of Kumaun upto to the frontiers of Garhwal, Tibet and Western Nepal. He recorded a total of 185 species of ferns belonging to 30 genera and 15 species of fern — allies spread over 6 genera based on the collections made by Strachey and Winterbottom during the year 1946-1849. Later, Loyal & Verma (1960), Pande (1972), Verma & Khullar (1980) and Pangtey *et al.* (1982) made significant contributions to the fern flora of Kumaun Himalaya. Further, Dhir (1980) made the most comprehensive study on the fern flora of North-Western Himalaya from

Kumaun to Kashmir based on his collections and earlier collections housed in different herbaria of India.

During the course of explorations of Pteridophytic flora of Kumaun and Naini Tal. 7 species of ferns and one species of fern allies were found to be new to the Pteridophytic flora of Kumaun. Among these 7 species, 4 species of ferns, i.e. *Polystichum prescottianum* (Wall. ex Mett.) Moore var. *castaneum* Clarke, *P. wilsonii* Christ., *Cystopteris dickieana* R. Sim. and *Pronephrium penangianum* (Hook.) Holtt. are new records for Kumaun. While *Selaginella involvens* (Swartz) Spring, *Polystichum*